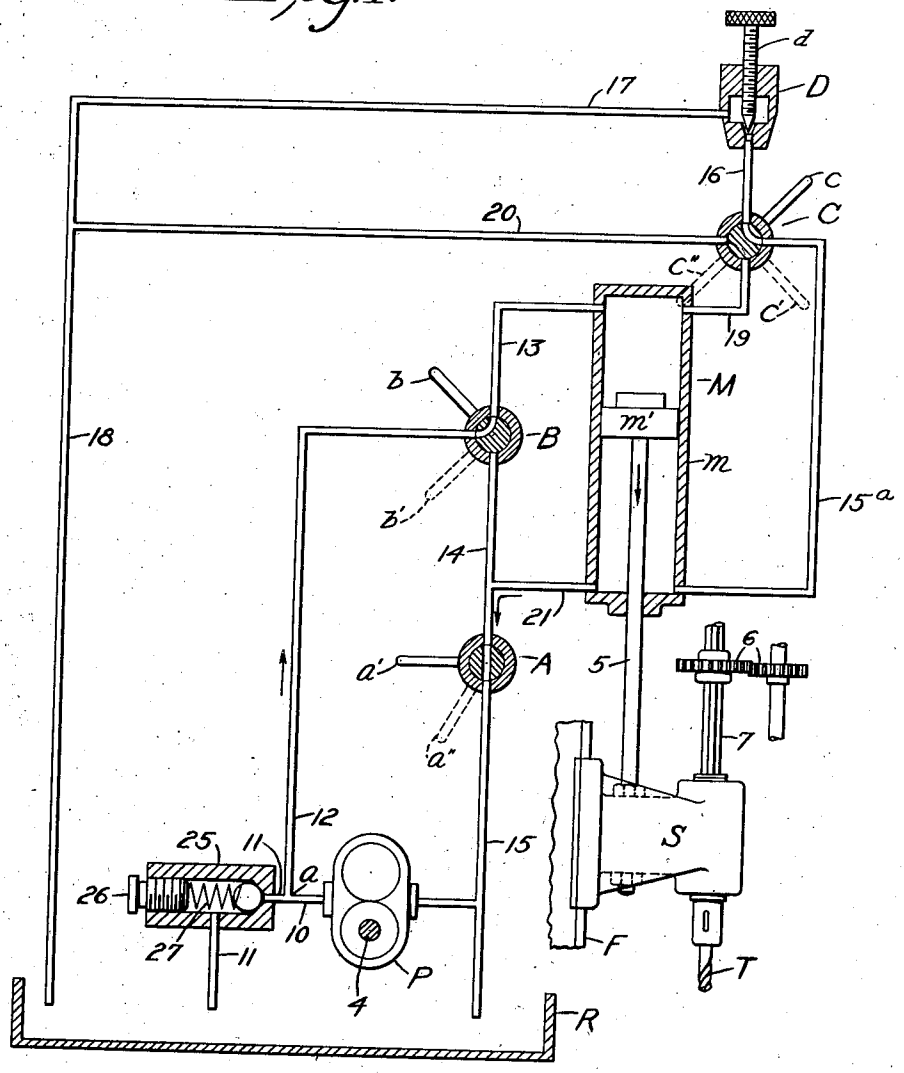
Feb. 5, 1935. A. M. SOSA 1,990,052

FLUID ACTUATED DRILL FEED

Filed Dec. 4, 1930 3 Sheets-Sheet 1

Fig. 1.



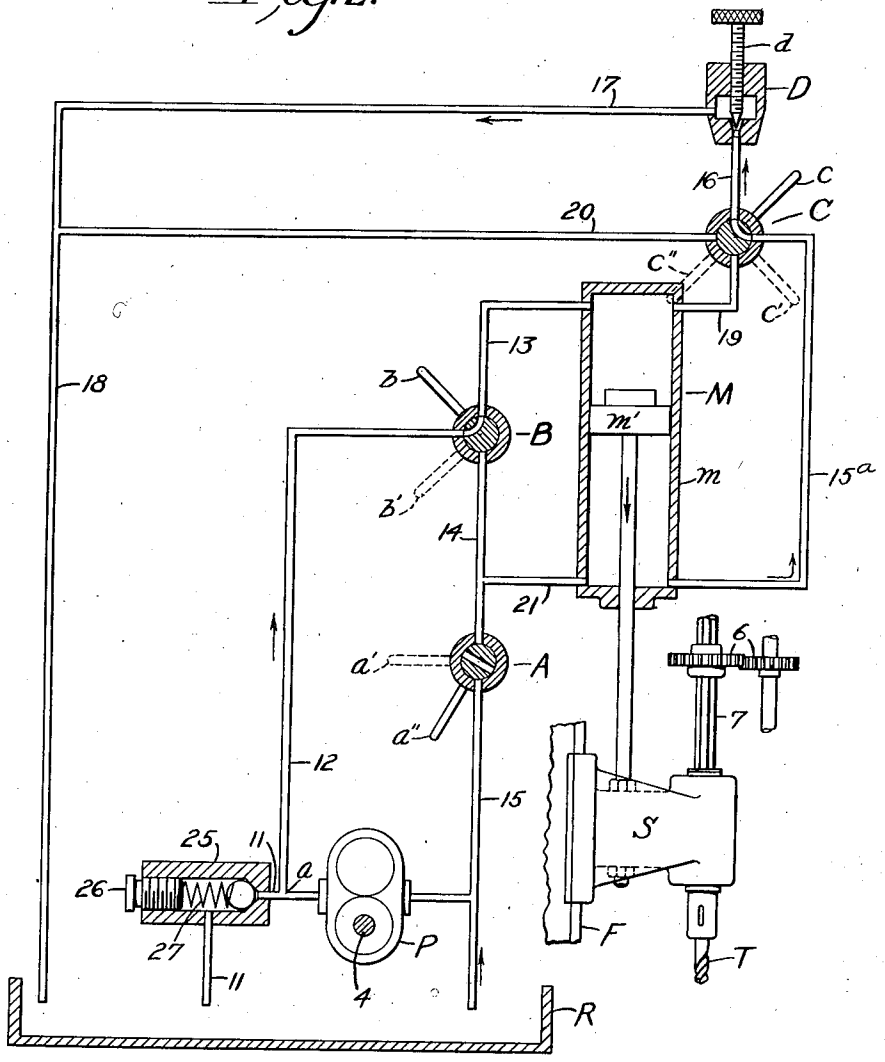
Inventor
Augustus M. Sosa
By Attorneys
Nathan & Bowman

Feb. 5, 1935. A. M. SOSA 1,990,052

FLUID ACTUATED DRILL FEED

Filed Dec. 4, 1930 3 Sheets-Sheet 2

Fig. 2.



Inventor
Augustus M. Sosa
By Attorneys
Nathan & Bowman

Feb. 5, 1935. A. M. SOSA 1,990,052

FLUID ACTUATED DRILL FEED

Filed Dec. 4, 1930 3 Sheets-Sheet 3

Fig. 4.

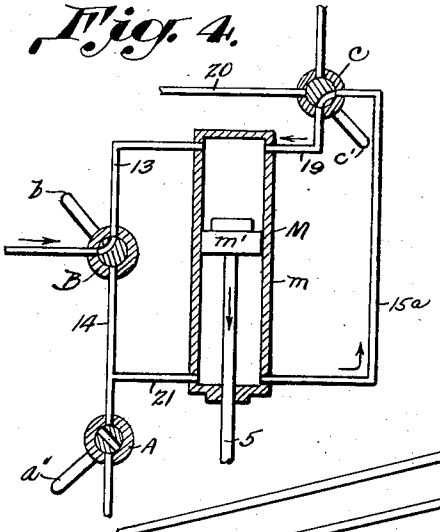


Fig. 3.

Inventor

Augustus M Sosa

By Attorneys'

Nathan & Bowman

Patented Feb. 5, 1935 1,990,052

UNITED STATES PATENT OFFICE

1,990,052

FLUID ACTUATED DRILL FEED

Augustus M. Sosa, Cincinnati, Ohio, assignor to The Cincinnati Bickford Tool Company, Cincinnati, Ohio, a corporation of Ohio

Application December 4, 1930, Serial No. 500,005

11 Claims. (Cl. 60—52)

This invention relates to hydraulic circuits for machine tools and particularly to those types of hydraulic circuits in which the rate of advance or movement of the machine element is controlled by the rate at which fluid is permitted to be discharged from the exhaust side of the motor.

It has for its main object to provide an hydraulic circuit capable of utilizing a standard make gear pump for effecting the feeding and traversing movements of the machine element in place of the relatively more expensive types of pump units, such as, for example, pumps of the reciprocating piston type.

Another object of this invention is to provide a system wherein the discharge from the pump may run pressure free or substantially so, to the reservoir at all times except during feeding movements, thereby to relieve the load upon the pump and its driving means and thus prevent unnecessary heating of the oil and undue wear upon the parts. And as an additional refinement to provide a means for automatically bypassing a fraction of or all of the supply fluid whenever the pressure in the supply line tends to exceed a predetermined maximum.

Still a further object of this invention is to provide an hydraulic system with but few operating parts easily constructed and assembled, for selectively imparting feeding and traversing movements to a machine element.

In the attainment of the objects of this invention, I propose to use a constantly driven gear pump for providing the desired pressures and flows and pass substantially the entire discharge therefrom to the hydraulic motor, through a system of conduits, and to locate a needle valve or throttle in series with the motor. In order to avoid all possibility of excessive pressures arising in the system an adjustable relief valve is placed in the supply line to permit an outflow therefrom whenever the pressure exceeds a preselected maximum. The valves and conduits are so constructed and arranged that the movement, whether manually or automatically, of one of the valves from one position to another changes the rate of travel from a traversing rate to a feed rate and conversely, while movement of a second valve controls the direction of travel, and movement of a third valve, from one position to another, effects changes in the rate of travel from fast to slow, or conversely, as well as the direction of movement.

Cooperating with the selector valves is the adjustable throttling means of a conventional form, preferably positioned in a motor discharge line, for controlling the rate of movement of the carrier, and effective only when the valves are positioned for effecting a feeding rate of movement.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Figure 1 illustrates an embodiment of this invention as applied to a drilling machine, the parts being arranged to effect a traversing movement to a sliding carriage. Fig. 2 is a similar diagram but with the parts arranged for effecting a slow movement or feeding movement to the carrier. Fig. 3 is a diagram illustrating the parts in a position for effecting a return movement of the carrier. Fig. 4 diagrammatically illustrates the parts positioned to effect a rapid traverse movement of the carrier.

Referring more particularly to Fig. 1 the hydraulic motor M is operatively connected with a sliding tool carriage S, as by means of the piston rod 5, but it is to be understood, however, that either element of the motor may be connected with the work carrier or tool carrier as the installation requires. In this particular application the tool T is rotated by means of the gears 6, one of which has a splined connection with the spindle 7 journaled in the support S which is mounted for translation upon the bed or frame F of the machine.

Propulsion of the support S is effected hydraulically, the pressure fluid being supplied by a pump P, driven from a shaft 4, which urges the fluid through line 10 to a point *a* where it branches, one branch 11 leading to the reservoir R and another branch 12 leading to a direction control valve B. With the valve in the position *b* illustrated in Fig. 1, fluid is directed through conduit 13 to the large end of the cylinder *m* and urges the piston *m'* and parts connected therewith forwardly. At the same time fluid is discharged from the small end of the cylinder through lines 21 and 14, valve A (which for a traversing movement is open or in the position *a'*),

and line 15 to the pump and reservoir; the support S is thereby caused to be moved at a traverse rate.

When the work piece is reached, valve A is moved to the position *a''* either manually or by suitable trip mechanism operated by the carriage, to cut off the free discharge to the reservoir. The motor discharge then passes through exhaust line 15ª to a valve C, which, in the position *c* illustrated in Fig. 2, directs the fluid through discharge line 16 to a serially arranged variable resistance element D and thence to discharge lines 17 and 18 to the reservoir.

The rate or velocity of flow through the throttle D and thus the rate of advance of the carrier S, is determined by the setting of the throttling member *d*. With such a system there will always be a greater pressure in the forward pressure line, if there is to be any movement of the carrier at all, than in the back pressure line and, during the tooling operations, the throttle D limits the rate of discharge and causes a back pressure of a value sufficient to prevent a "jumping" of the carrier when the value of the work resistance changes.

If the conditions of operation are such that a rapid traverse movement is required, as for example, to shorten the distance between tool and work and before engaging the work the valve C may be first moved to the position *c'* (indicated by the dotted lines in Fig. 2), connecting exhaust line 15ª with line 19 and the large end of the cylinder. Both ends of the cylinder are then under pressure but due to the differential in the effective areas of the piston *m'*, the carrier S will be moved forward as before but at an increased rate and with a consequent reduction in power. When tool and work are in close proximity the valves may be tripped as above explained, to effect, if desired, an intermediate traverse rate followed by the feed rate or to effect a feed rate alone.

Or if the valve C be turned to the position indicated by the reference character *c''*, the fluid passes from line 13 directly to exhaust line 19, valve C, and discharge line 20 back to the reservoir R and the head S comes to rest, the throttle D being thus cut out of the circuit at this time.

For effecting a traverse movement in the opposite direction, as for example, at the completion of the drilling operation, the direction control valve B is moved to the position *b'* (Fig. 3). Pressure fluid is then directed through lines 14 and 21 to the small end of the cylinder and the fluid discharged from the large end is passed through line 19 to the rate and direction control valve C and thence through lines 20 and 18 to the reservoir. The outflow from the motor being unrestricted, the carriage S is caused to return at a rapid rate.

The travel of the carrier may be suspended at the completion of its stroke or at any time during the return movement by adjusting the rate valve A so as to pass the pressure fluid directly to the reservoir through the line 15. Thus it will be seen that the travel of the carrier may be stopped at any point in its travel, and the pressure in the system and the load upon the pump immediately reduced to a minimum, merely by the opening either of the valves A or C to the reservoir.

Obviously various other cycles of movement may be imparted to the carrier by varying the sequence or order of movement of the valves. For example, to bring the head to a stop and to insure that it will not creep forward or be accidentally moved forward, valve C is moved to position *c''* (the other valves in the position shown in Fig. 2) thereby trapping the fluid in the discharge end of the motor and opening the intake end to the reservoir. Similarly when moving in the reverse direction, valve C (Fig. 3) may be moved to cut off the discharge from the large end of the motor and valve A opened to by-pass the propelling fluid directly to the reservoir.

To effectively lock the carrier against movement in either direction, the valve mechanisms may be moved to intermediate positions to block all flow of fluid to and from the motor. Under these conditions, the supply fluid will then be passed through a pressure control element 25.

As an additional refinement, this invention proposes a means for guarding against excessive stresses or damage to the tool or work in the event that the carrier S meets an obstruction, or, to prevent the pressure in the forward pressure line of the system from exceeding a predetermined value however caused, the pressure controller 25, adjustable to suit requirements, is inserted in the pump outflow branch line 11. Thus, when the forward pressure exceeds a preselected maximum, as for example, by reason of an increase in the work resistance, the valve 25 opens and by-passes the excess fluid to the reservoir. Likewise, in the event that the carrier S or tool T meets an obstruction, the by-pass valve opens and further travel of the carrier is suspended. An adjusting screw 26 is provided for varying the effectiveness of the spring 27 to increase or decrease the pressure required to open the relief line to the reservoir.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of United States:—

1. An hydraulic system combining an hydraulic motor M; a reservoir R; a gear pump P for supplying fluid under pressure to said motor; a control valve B and a variable resistance element D connected in series with said pump and motor; a shunt circuit 15 connected in parallel with said variable resistance and also connected with said control valve B and with said reservoir; a second control valve A in said shunt circuit; and means for actuating said valves for directing the flow of fluid selectively through said motor and resistance element, or through said motor and said second control valve, or through said second valve directly to said reservoir.

2. An hydraulic transmission of the discharge regulated type combining an hydraulic motor having a cylinder and a piston of the differential type; a pump for supplying fluid to said motor; a reservoir; fluid conduits and valve means for alternatively connecting either end of said motor with said pump and auxiliary valve means for selectively connecting either end of said motor with said reservoir or both ends of said motor together so constructed and arranged that for a given setting of the auxiliary valve means the discharge from the motor during a forward stroke passes to the reservoir to effect a given rate

of movement thereof and for another setting of said valve means the discharge from said motor during a forward stroke augments the quantity supplied by the pump to the other end of the motor to effect an increase in the rate of motor movement; and means for selectively actuating said valve means.

3. An hydraulic system for a machine tool combining an hydraulic motor of the differential piston type; a supply conduit connected with the intake side of said motor and a motor discharge conduit connected with the opposite side thereof; a pump for supplying fluid to said motor; a variable resistance element in said discharge conduit; valve means in said discharge conduit between said resistance element and said motor, said valve means also being connected with the intake side of said motor; and means for selectively positioning said valve means to direct the motor discharge fluid through said resistance element or to the intake side of said motor.

4. A machine tool combining a translatable carriage; means for effecting translation of said carriage, said means including an hydraulic motor connected with said carriage and provided at one end with an intake conduit and at its opposite end with two discharge conduits, one of said discharge conduits being normally open; a source of fluid under pressure connected with said intake conduit; means located in one of said discharge conduits for controlling the rate of flow therethrough thereby to control the rate of movement of said motor; and valve means for directing the fluid discharged from said motor selectively through said discharge conduits.

5. An hydraulic system including a reversible differential hydraulic motor; a pump for supplying fluid under pressure to said motor; a system of conduits for conveying fluid to and from said pump and motor including a first normally open motor discharge conduit and a second conduit having therein a normally fixed resistance, said first discharge conduit affording an unrestricted passage for the discharge fluid; a series of valves for controlling the action of said motor including a stop valve in said normally open conduit, a direction control valve in the conduit connected with the intake side of said motor and a selector valve connected with said second discharge conduit and operative when said stop valve is closed to permit fluid discharged from said motor to pass through said second discharge conduit or to direct it into the intake side of said motor; and means for actuating said valves.

6. An hydraulic system for machine tools combining a differential reciprocating motor; a pump and suitable conduits for supplying actuating fluid to said motor; a valve in said conduits for selectively directing the actuating fluid to either end of said motor; an exhaust conduit connected with each end of said motor; a rate selector valve connected with each of said exhaust conduits; a discharge line connected with said rate selector valve; a throttle in said discharge line for restricting the flow of fluid therethrough; and means for selectively shifting said rate selector valve to one position in which it connects said exhaust conduits thereby to permit the fluid discharged from one end of the motor to enter the opposite end of the motor and combine with the actuating fluid to effect rapid actuation of the motor or to another position in which it connects one of the exhaust conduits with said discharge conduit thereby to effect slow actuation of said motor under the influence of the actuating fluid.

7. A machine tool combining a translatable carriage; means for effecting reciprocations of said carriage said means including a reversible hydraulic motor connected with said carriage and provided at each end with independent intake and exhaust ports; a source of fluid pressure; a direction control valve and suitable conduits for connecting said source selectively with the intake ports of said motor; a discharge conduit connected with each of said exhaust ports, one of said discharge conduits being normally open to permit unobstructed flow of fluid therethrough when said motor is operated in one direction; means in the other discharge conduit for controlling the rate of flow therethrough thereby to control the rate of movement of the motor in the opposite direction; and other valve means, independent of said direction control valve, connected with said discharge conduits and adapted to render said open discharge conduit effective when said motor is operated in one direction and to render the other discharge conduit effective when the motor is operated in the opposite direction.

8. An hydraulic system including a reversible differential hydraulic motor; a pump for supplying fluid under pressure to said motor; a system of conduits for conveying fluid to and from said pump and motor including a first normally open discharge conduit and a second discharge conduit having therein a normally fixed resistance, said open conduit affording an unrestricted passage for the discharged fluid during rapid actuation of said motor; a series of valve mechanisms for controlling the action of said motor including a direction control valve located in the conduit connected with the intake side of said motor; a selector valve in the motor discharge conduits operative to direct the motor discharge fluid to said first discharge conduit during movement of said motor in one direction, and selectively through said second discharge conduit or to the intake side of said motor during movement of said motor in the opposite direction; and means for actuating said valves.

9. An hydraulic circuit combining an hydraulic motor of the cylinder and piston type; a source of fluid pressure adapted to be connected selectively with the opposite ends of said motor to actuate said motor in forward and reverse directions; an exhaust conduit connected with each end of said motor; a valve connected with both of said exhaust conduits; two discharge conduits connected with said valve, one of said discharge conduits being normally open and affording an unobstructed flow for the discharged fluid thereby to effect rapid actuation of said motor; and a throttle valve in the other of said discharge conduits to effect a reduced rate of actuation of said motor; the first mentioned valve being adapted to connect one of said exhaust conduits with the normally open discharge conduit during actuation of said motor in one direction and with the other discharge conduit during actuation of the motor in the other direction.

10. An hydraulic system for machine tools combining a reciprocating hydraulic motor; a pump and suitable conduits for supplying actuating fluid to said motor; a valve in said conduits for selectively directing the actuating fluid to either end of said motor; exhaust conduits connected with the opposite ends of said motor; a control valve connected with both of said exhaust conduits; first and second discharge conduits connected with said control valve, said first discharge conduit affording an unrestricted passage for fluid dis-

charged by said motor when actuated in one direction; a throttle valve in said second discharge conduit adapted to restrict the flow of fluid therethrough during actuation of the motor in the opposite direction thereby to reduce the rate of movement of said motor; and means to shift said control valve to a position to connect one of said exhaust conduits with said second discharge conduit when the actuating fluid is admitted into one end of said motor and to connect the other exhaust conduit with said first discharge conduit when actuating fluid is admitted into the other end of said motor.

11. An hydraulic circuit combining a reversible differential hydraulic motor of the cylinder and piston type; a source of fluid pressure adapted to be connected selectively with the opposite ends of said motor; an exhaust conduit connected with each end of said motor; two discharge conduits adapted to be connected with said exhaust conduits respectively one of said discharge conduits being normally open, a throttle device in the other of said discharge conduits to restrict the flow of discharged fluid therethrough; and a valve connected with both of said exhaust conduits and with both of said discharge conduits, said valve being adapted selectively to connect one of said exhaust conduits with said normally open discharge conduit to effect relatively rapid actuation of said motor in one direction or to connect the other of said exhaust conduits with the other of said discharge conduits thereby to effect relatively slow actuation of the motor in the opposite direction or to connect together said two exhaust conduits to connect the discharge end of the motor with the intake end thereof, thereby to effect actuation of the motor at a rate higher than said rapid rate.

AUGUSTUS M. SOSA.